

# TPC Simulation Update

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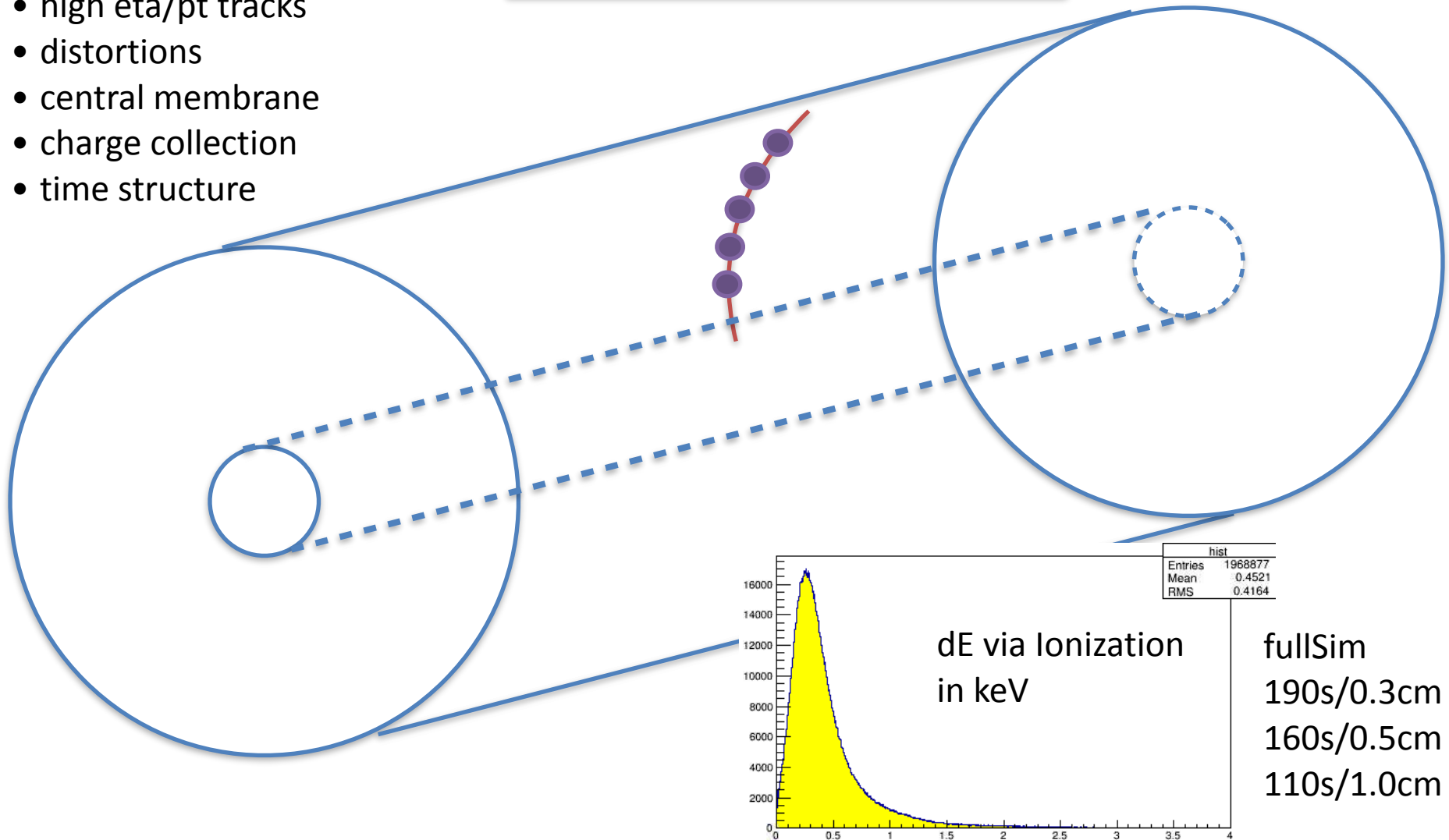
Carlos Perez (SBU)

# One big active volume

Better description of

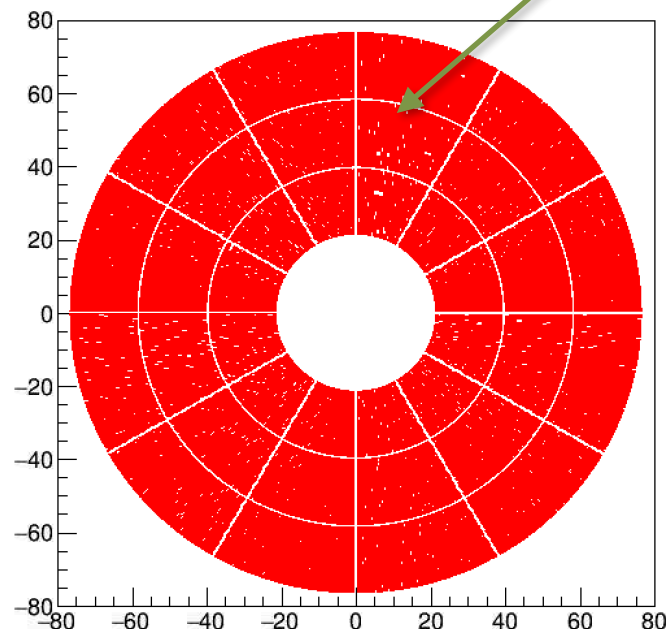
- high eta/pt tracks
- distortions
- central membrane
- charge collection
- time structure

StepLength is controlled via Geant4



# TPC Simulation starts after G4 hit

Transport  
Distortions  
Amplification  
Electron capture



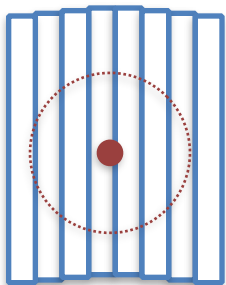
```
List of Nodes in Fun4AllServer:
Node Tree under TopNode TOP
TOP (PHCompositeNode)/
  DST (PHCompositeNode)/
    PHG4INEVENT (PHDataNode)
    PHHepMCGenEvent (IO,PHHepMCGenEvent)
    PIPE (PHCompositeNode)/
      G4HIT_PIPE (IO,PHG4HitContainer)
    SVTX (PHCompositeNode)/
      G4HIT_SVTX (IO,PHG4HitContainer)
      SvtxHitMap (IO,SvtxHitMap_v1)
      SvtxClusterMap (IO,SvtxClusterMap_v1)
      SvtxTrackMap (IO,SvtxTrackMap_v1)
      SvtxVertexMap (IO,SvtxVertexMap_v1)
      TPCHits (IO,PHObject)
    MAGNET (PHCompositeNode)/
      G4HIT_MAGNET (IO,PHG4HitContainer)
      G4HIT_BH_1 (IO,PHG4HitContainer)
      BH_FORWARD_PLUS (PHCompositeNode)/
        G4HIT_BH_FORWARD_PLUS (IO,PHG4HitContainer)
      BH_FORWARD_NEG (PHCompositeNode)/
        G4HIT_BH_FORWARD_NEG (IO,PHG4HitContainer)
      G4TruthInfo (IO,PHG4TruthInfoContainer)
      BBC (PHCompositeNode)/
        BbcVertexMap (IO,BbcVertexMap_v1)
      G4CELL_SVTX (IO,PHG4CellContainer)
      TPCDigits (IO,PHObject)
    GLOBAL (PHCompositeNode)/
      GlobalVertexMap (IO,GlobalVertexMap_v1)
```

still used to keep framework intact

new internal consumable

new internal consumable

# Pad Matching



sketch of pads in  
traverse plane and  
cloud from  
microsimulation

Cloud is projected into RO geometry.  
Algorithm computes range of pads  
compatible with cloud centroid and  
spread and return range of pairs  
(PAD;QUOTA)

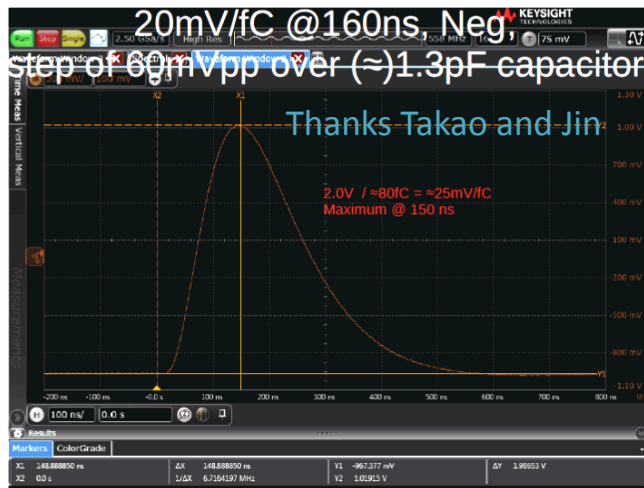
Quotas are computed using PDF in  
cylindrical coords. CDF is obtained  
by integrating in radius to cover  
layer and simplifying based on  
small angle approximation.

Example of two hits left by track from Central Hijing ev.

```
PushCloud2Module 56
CLOUD WEIGHT 30000 to be stored in 8 pads.
  PAD 1129(8) weight 92.076 to be stored in 4 time bins.
  PAD 1130(8) weight 1332.66 to be stored in 5 time bins.
  PAD 1131(8) weight 1084.78 to be stored in 5 time bins.
  PAD 1132(8) weight 48.7581 to be stored in 4 time bins.
  PAD 1257(9) weight 932.654 to be stored in 5 time bins.
  PAD 1258(9) weight 12120.9 to be stored in 7 time bins.
  PAD 1259(9) weight 8855.97 to be stored in 6 time bins.
  PAD 1260(9) weight 353.867 to be stored in 5 time bins.
==> SUM PAD WIGHTS 24821
PushCloud2Module 56
CLOUD WEIGHT 16000 to be stored in 6 pads.
  PAD 1130(8) weight 47.9372 to be stored in 3 time bins.
  PAD 1131(8) weight 20.6066 to be stored in 3 time bins.
  PAD 1257(9) weight 1238.98 to be stored in 6 time bins.
  PAD 1258(9) weight 8547.83 to be stored in 6 time bins.
  PAD 1259(9) weight 3292.65 to be stored in 6 time bins.
  PAD 1260(9) weight 65.2591 to be stored in 5 time bins.
==> SUM PAD WIGHTS 13213
PushCloud2Module 56
```

# Pulse shape

IPC Shaping time measurement



Example of sampling at 10 MSPS

```
PAD 458(3) weight 164.358 to be stored in 8 time bins.
TIME 288 weight 3
TIME 289 weight 32
TIME 290 weight 58
TIME 291 weight 29
TIME 292 weight 21
TIME 293 weight 11
TIME 294 weight 5
TIME 295 weight 1
==> SUM TIME WIGHTS 160
PAD 459(3) weight 840.758 to be stored in 9 time bins.
TIME 288 weight 17
TIME 289 weight 164
TIME 290 weight 300
TIME 291 weight 151
TIME 292 weight 107
TIME 293 weight 60
TIME 294 weight 26
TIME 295 weight 9
TIME 296 weight 2
==> SUM TIME WIGHTS 836
PAD 460(3) weight 1213.47 to be stored in 9 time bins
```

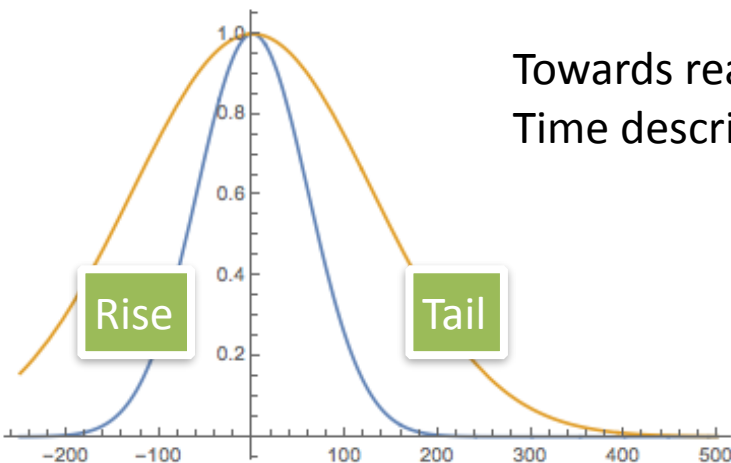
6/23 to 6/24/ 2016

Annual BTU TCSM Review

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Plot[{Exp[-0.5 (x)<sup>2</sup> / 60<sup>2</sup>], Exp[-0.5 (x)<sup>2</sup> / 130<sup>2</sup>]}, {x, -250, +500}  
PlotRange -> All]

Towards realistic  
Time description



Possible use time shape to  
deconvolute occupancy?

# Status of this development

- New simulation incorporates crucial aspects of the TPC not addressed yet: dEdX, GEM amplification and Pulse Shape
- Incorporated into Fun4All framework: subsystems and input/output
- From G4Hits to TPCDigits all done: In-gas transport, GEM, Digitizer, rectangular RO pads matching
- Clusterer not yet ready. Needs fine-tune to account for pulse shape
- All contained in parallel library (does not interfere with current Svtx libs)
- 20 new files ready: TPCConstants TPCDataTypes TPCDigit  
TPCPadMapTPCDigitsContainer TPCCloud TPCDetector  
TPCDetectorSubsystem TPCEventAction TPCSimulation  
TPCSimulationSubsystem TPCSteppingAction